FRONTIERS OF PHOTOGRAPHY

PROGRAM

ANNUAL CONFERENCE ON PHOTOGRAPHIC SCIENCE AND ENGINEERING

SHERATON-CLEVELAND HOTEL, CLEVELAND, OHIO
May 17-21, 1965

SPSE

Society of Photographic Scientists & Engineers
P.O. Box 1609, Main Post Office, Washington, D. C. 20013

Co-Sponsor

Systems Engineering Group
Research and Technology Division
U.S. Air Force Systems Command

Appointments

Monday

Tuesday

Wednesday

Thursday

Friday

President's Welcome

Welcome to the 1965 Conference of the Society of Photographic Scientists and Engineers. Speaking on behalf of the Society and its Chapters, the Board of Directors, and the Conference Committees, I would like to welcome you to Cleveland. I sincerely hope that you will find this Conference both informative and enjoyable. Represented at this SPSE Conference are some of the outstanding authorities and manufacturers in the field of photographic science and engineering all over the world. You will have the opportunity to hear about and explore some of the many products, processes, and practices which serve the photographic community today.

For those of you participating in our Society's activities for the first time, I would like to give you some information about the Society of Photographic Scientists and Engineers. The SPSE considers its area of responsibility to be basic photographic science and engineering as well as applications in those fields. Major activities of the Society include not only an Annual Conference and an Annual Symposium, but many outstanding publications. Included are the *Journal of Photographic Science and Engineering*, the *SPSE News*, and the *Abstracts of Photographic Science and Engineering Literature*. The *SPSE Journal* and the *SPSE News* are sent to all members of SPSE as a part of their membership.

Additional information about Society membership may be obtained at the registration desk or from any of the present Society officers or members. I hope that this Conference will be a rewarding experience for you.

Sincerely,

R. E. Birr
President

Additional information and membership applications can be obtained at the Conference Registration desk or by writing to the Society's headquarters:

Society of Photographic Scientists and Engineers

Box 1609, Main Post Office, Washington, D. C.

Calendar of Events*

Sunday, May 16th

1:30 PM	**Board of Director's Meeting** (Terminal Room)
6 PM to 10 PM	**Registration***
Evening	**Get Acquainted Buffet**

Monday, May 17th

8 AM to 5 PM	**Registration***
9 AM to 12 Noon	**Papers:*** *Photography in Earth Reconnaissance*
12:30 PM to 2 PM	**Welcoming Luncheon** (Cleveland Room) *Guest Speaker:* Brig. Gen. Y. A. Yancey, AFR
2 PM to 5 PM	**Papers:*** *Photographic Systems in Earth and Space Reconnaissance*
	Panel Discussion:* *Stabilization of Satellite-Borne Reconnaissance Systems*
8:15 PM to 10 PM	**Papers:*** *The Information Copy Revolution and Its Problems*

Tuesday, May 18th

8 AM to 5 PM	**Registration***
9 AM to 12:30 PM	**Papers:*** *Image Evaluation*
2 PM to 2:45 PM	**Papers:*** *Image Evaluation (Continued)*
2:45 PM to 3:45 PM	**Panel Discussion:*** *Education for Photographic Engineering from the Engineer's Viewpoint*
3:45 PM to 5:30 PM	**Papers:*** *Medical Photography*
7 PM	**Tour:** *G. E. Lighting Institute—Nela Park*

Wednesday, May 19th

8 AM to 5 PM	**Registration***
9 AM to 12 Noon	**Papers:*** *Lasers in Photography*
12:30 PM	**Chapter Presidents' Luncheon** (Navahoe Room)
2 PM to 5:30 PM	**Papers:*** *Unconventional Photographic Systems*
6 PM to 7:30 PM	**Social Hour** (Gold Room)

* *Registration*—Mezzanine
Papers Sessions and Panel Discussions—Gold Room
SPSE Office—East Room
Press Room—Director's Room

Calendar of Events*

Thursday, May 20th

8 AM to 5 PM	**Registration***
9 AM to 12 Noon	**Papers:*** *Rapid Processing*
2 PM to 5 PM	**Papers:*** *Image Formation and Manipulation*
6:30 PM to 7:30 PM	**Assembly A—Cash Bar**
7:30 PM	**SPSE Annual Banquet** (Gold Room)

Friday, May 21st

8 AM to 12 Noon	**Registration***
9 AM to 12 Noon	**Papers:*** *Further New Theory, Mechanisms, and Materials*
2 PM to 4 PM	**Papers:*** *Engineering Exhibits Presentations*

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* *Registration*—Mezzanine
Papers Sessions and Panel Discussions—Gold Room
SPSE Office—East Room
Press Room—Director's Room

Exhibit Schedule

(Whitehall Room)

Monday, May 17th	6 PM to 8 PM
Tuesday, May 18th	11 AM to 5 PM
Wednesday, May 19th	11 AM to 5 PM
Thursday, May 20th	11 AM to 5 PM

Memos

Schedule of Papers

Monday Morning, May 17th

Photography in Earth Reconnaissance

Session Chairman: R. G. TARKINGTON

1 **The Chromatic Characteristics of Additive Color Aerial Photography,** E. YOST AND S. WENDEROTH, *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, Long Island, N.Y.*

The chromatic accuracy obtainable from color aerial photography taken using the additive color principle is discussed. Additive color aerial photography is obtained by the simultaneous imaging of reflected electromagnetic radiation from the terrain through selected filters on a suitable achromatic recording medium. Practically, this involves the simultaneous exposure of a number of spatially identical, filtered photographs on a silver halide emulsion. When such photographs are projected through a linear compensation of the taking filters, the superimposed image is seen in color. The accuracy of the color representation of the scene referenced to a given standard is dependent on a number of factors which include: the filter–lens–emulsion combination in the taking camera; the accuracy with which the characteristic curves of the individual photographs can be imaged in processing; the chromatic light scattering effects of the projecting system; as well as variations in the spectral quality of the scene illuminant and the variable attenuation of the atmosphere. The relationship of object color in the scene to image color, as viewed by an observer, will be presented in terms of I.C.E. chromaticity coordinates. These coordinates are computed from spectrophotometric data using the weighted ordinate method. The effect of lens–filter interaction with panchromatic and nonuniform spectral sensitivity emulsions will be analyzed. Compensation for chromatic inaccuracies in viewing due to the previously mentioned effects can be partially adjusted for the entire scene by variation of the hue, brightness, and saturation of the image. The extent to which this correction can be accomplished will be demonstrated.

2 **Films and Plates for Aerial Color Photography,** ALLAN L. SOREM, JAMES S. MOSER, AND J. MASON BURNHAM, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

The different requirements of high- and low-altitude aerial reconnaissance, mapping, coast and geodetic, geo-

logical, and agricultural surveys, and other applications of aerial color photography, can be met by selecting a film having a suitable combination of speed, contrast, and definition from several Kodak aerial color materials now available. These include a high-speed, medium-gamma film for low-altitude reconnaissance, a duplicating film, and reversal color diapositive plates for use in first-order plotters. Integrated systems for aerial color photography are discussed, and information is presented about the sensitometric, image structure, and processing characteristics of Kodak aerial color films and a color diapositive plate.

3 **The Change of Aerial Camera Exposure with Solar Altitude,** M. R. SPECHT, N. L. FRITZ, AND A. L. SOREM, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

The relationship between solar altitude and apparent scene luminance for aerial photography has been determined by the evaluation of a series of aerial photographs made of specific scenes at solar altitudes ranging from 68 to $-1°$. Variations, as a function of solar altitude, in the apparent luminances of individual details, as well as in luminance distributions, were obtained from microdensitometer measurements on the negatives. The results are compared to the curves relating solar altitude with illuminance on a horizontal plane and with Jones' and Condit's luminous density. Significant differences among these relationships are noted.

4 **Luminance Distributions in Aerial Scenes,** A. L. SOREM, N. L. FRITZ, AND M. R. SPECHT, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

The distributions of the apparent luminances of representative aerial scenes have been determined from photographs made at five altitudes from 1000 to 16,000 ft. In each test, the apparent luminances of 5000 2-ft-diameter areas were measured by microdensitometer readings on the negatives. Test variables included haze, solar altitudes, and effective film spectral sensitivities. The data will assist in determining camera exposures and exposure latitudes required for maximum quality in both low- and high-altitude aerial photography.

5 **Phase Angle and the Brightness of Objects,** VICTOR J. SLABINSKI, *Case Institute of Technology, Cleveland, Ohio*

Whether or not a photographic trace of a sunlit artificial earth satellite can be obtained under stated conditions

may depend on the phase angle between the direction in which the object is viewed and the direction of the illumination. Satisfactory prediction of apparent brightness requires that the effect of phase angle be calculated. The classical formulae attributed to Euler and to Lambert are shown to be in poor agreement. Observed variations in brightness of artificial earth satellites attributable to phase angle are evaluated.

6 **A Program for Cataloguing Reports on Apparent Satellite Brightness,** THOMAS W. PETRIE, *Andrew Jennings Computing Center, Case Institute of Technology, Cleveland, Ohio*

A computer program is described to which the inputs are mean orbital elements of an identified satellite, station coordinates, coordinates and brightness of a companion star, and apparent relative brightness. The program outputs: (1) a letter to the observer confirming (or denying) the identification and reducing the reported brightness to normalized viewing conditions; applying the equations of Euler, Lambert, and sin ½ elongation angle; and (2) a merger of the reduced data in a catalog of such reports on all satellites.

7 **Modulation Transfer Characteristics of Water of Controlled Turbidity,** G. G. FULMER AND H. M. GREENBERG, *School of Photography, Rochester Institute of Technology, Rochester, N.Y.*

A sinusoidal object was photographed through a specially constructed tank containing turbid water. The changes in modulation at varying spatial frequencies and image contrast were evaluated for several levels of turbidity. The controlled turbidity, produced by a calcium oxalate suspension, is specified by three independent measurements: nephelometry, photometric transmittance, and concentration expressed as PPM. Data have been obtained indicating the relationship between the amount of turbidity present and the change in image contrast at varying spatial frequencies, or MTF.

Monday Afternoon, May 17th

Photographic Systems in Earth and Space Reconnaissance

Session Chairman: NORTON GOODWIN

8 **Characteristics of Image Motions in Aerial Cameras,** EARLE B. BROWN, *The Perkin-Elmer Corporation, Norwalk, Conn.*

Image motions in aerial cameras result from apparent ground motion due to vehicle forward velocity and also from camera and vehicle angular motions. Their magnitude and direction depend upon directions of camera pointing as well as upon vehicle velocity and altitude. These motions have been analyzed as functions of position in the camera focal plane, and divided into components in longitudinal and lateral directions. There are five distinct patterns of motion in each direction. The simple first-order terms are well known and are corrected by conventional techniques. The second order terms which arise when oblique pointings are involved are of interest in high-performance applications, and will call for new techniques of compensation. The nature of the five patterns is described and the conditions for their occurrence are identified.

9 **Electronic Image Motion Stabilization,** EFRAIM R. ARAZI, *Itek Corporation, Lexington, Mass.*

A technique has been developed that enables photographing scenes that move or vibrate with respect to the camera. This situation arises when cameras or telescopes are subjected to vibration and when the object to be observed moves or vibrates. Essentially the technique involves conversion of the object optical image into an electron stream. The electron stream is converted back to an optical image on a phosphor screen. When the image is in the electron stream state, it can be moved in two dimensions by means of electromagnetic fields generated by deflection coils. Two systems are described: (1) The position of the image on the phosphor screen is sensed by an electro-optical sensor whose output is fed to the deflection coils. This feedback system strives to stabilize the output image at a null location, at all times independent of the motion or vibration of the input image. It is particularly useful in photography of planets, the moon, or objects in space in the presence of a scintillation or telescope vibration. (2) The motion of the complete camera is sensed by inertial sensors which control the deflection coils. This is suitable for aerial cameras and hand-held telescopes or movie (TV) cameras. Proto-

types of both system, and initial results obtained in lunar and planet photography will be demonstrated.

10 Atmospheric Shimmer and Its Effects upon Astrometric Photography of Celestial Objects as Observed with a Ground-Based, Telescope-Camera System, ROBERT H. WEITBRECHT, *Stanford Research Institute, Menlo Park, Calif.*

This paper describes some results that have accrued from several years of experience with an automatically guided astrometric camera on the 36-in. refractor telescope at Lick Observatory. Specifically, the question of image quality is explored. Various extrinsic factors such as seeing and guidance accuracy are considered. Experiments with a system of photography for obtaining high-definition photographs of the balloon satellite, ECHO I, are described, and results are shown. Because of atmospheric shimmer, as well as photographic peculiarities resulting from specular reflection of sunlight off the object's surface, this NASA-supported work was not successful. This problem is discussed in some detail.

Panel Discussion: Stabilization of Satellite-Borne Reconnaissance Systems

11 Photographic and Television Observation of the Erection of Large Structures in Space, DONALD P. ROGERS, *National Aeronautics and Space Administration, Washington, D.C.*

Several large structures have been erected in space—ECHO I and II and Pegasus I. Since these structures were so designed as to preclude realistic ground testing of their erection behavior in a 1-g environment, and since ground observation would be inadequate to record their erection in space with sufficient detail, spaceborne photographic and television systems were developed and used for this purpose. These systems along with required stabilization systems are described and film clips are shown of the erection in space of the two ECHO ballistic tests, the ECHO II orbital deployment, and the Pegasus unfolding.

12 Active Stabilization of Satellite-Borne Sensors for Meteorology, H. I. BUTLER, *Aeronomy and Meteorology Division, Goddard Space Flight Center, Greenbelt, Md.*

For meteorological purposes, two types of stabilization systems are being employed; one in which the attitude of

the spacecraft is controlled by a three-axis, active control system and the second in which the spacecraft spins (10 rpm) to provide the stability of a gyroscopic body. Simple camera and line–scan sensor systems can be readily accommodated on spinning spacecraft. However, the more advanced sensor systems which are capable of higher spatial or spectral resolution or increased sensitivity for night observation require the stability provided by the three-axis type of control system.

13 Passive Stabilization of Earth Orbiting Satellites, HENRY C. HOFFMAN, *Space Craft Systems Projects Division, Goddard Space Flight Center, Greenbelt, Md.*

Parts of an object in a free-fall system are subjected to minutely different gravitational forces. The gravitational gradient can be utilized in stabilizing an object so that it always projects the same aspect to the gravitational center of the system. Extension of the theory suggests the possibility of obtaining passive stabilization around the vertical axis also. Feasibility of passive satellite stabilization in earth reconnaissance systems is considered. Passive stabilization features of the Applied Technology Satellite (ATS) are described. The state-of-the-art in passive satellite stabilization is discussed. A review will be made of the disturbances encountered by gravity gradient satellites. These include eccentricity and aerodynamic, magnetic, and solar disturbances. Typical satellite libration curves will be presented.

13a Stabilization of Ranger and Mariner Reconnaissance Systems, GERALD W. MEISENHOLDER, *Jet Propulsion Laboratory, California Institute of Technology,* 4800 *Oak Grove Dr., Pasadena, Calif.*

Deep space, lunar, and planetary scientific spacecraft have been developed utilizing full three-axis attitude control. Celestial references of either Sun–Earth or Sun–Canopus are maintained by pulsing small cold gas nozzles when angular deviations from the references exceed approximately ¼ degree. Operating in such a limit cycle mode, the vehicle itself becomes a stable platform from which to perform photographic and scientific experiments.

Monday Evening, May 17th

The Information Copy Revolution and Its Problems

Session Chairman: LOUIS ROSENBLUM

14 *Invited Paper:* **Selective Dissemination of Information at NASA,** GIFFORD A. YOUNG, *Scientific and Technical Information Division, NASA, Washington, D.C.*

15 *Invited Paper:* **Information Processing Systems and Copyright Legislation,** NORTON GOODWIN, *Independent Tracking Coordination Program, SPSE, Washington, D.C.*

The current role of technical librarians as "leaks" in the classical copyright system is considered. The constitutional authority to "Promote the Progress of Science and Useful Arts. ." through copyright legislation is evaluated in the terms of current data storage, search, retrieval, reproduction, and transmitting systems, in all of which copying is of the essence. A set of legislative objectives is proposed, designed to encourage the commercial availability of data files in technical format on which a fixed reproduction fee would be the financial motivation, and in which periodic listing of the number of reproductions on each reproduced data file would be a byproduct. The value of frequency-of-use data in purging rapid-access data files is discussed. The case of compulsory licensing for "juke boxes" is noted and distinguished.

Tuesday Morning, May 18th

Image Evaluation

Session Chairman: WILLIAM S. SHOEMAKER

16 *Invited Paper:* **A Review of Current Image Evaluation Techniques,** G. C. BROCK, *Itek Corporation, Lexington, Mass.*

Spatial frequency analysis provides a valuable tool for photo-optical research and system design, but does not indicate quality in terms that relate directly to images as seen. Hence, resolving-power remains in use in spite of its failings. The paper criticizes the desire for a single-number, quality index, and discusses the significance of resolving-power, transfer function, single bar and acutance tests. It points out that the time is ripe for abandoning 3-bar, resolving-power in favor of specialized tests employing a frequency basis where appropriate in analysis or development, but a size or spatial base for expressing system performance.

17 **Variations of SMT Acutance with System Parameters,** M. C. GODDARD AND R. G. GENDRON, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y.*

Crane (1964) gave an empirical formula for SMT acutance

$$120\text{–}25 \log \sum_{i} (200 \times \text{magnification}/\text{MTC area}_i)^2$$

In this formula, the subscript "i" refers to the elements of a photographic system from the camera's lens to the observer's eye. The rates at which changes in the MTC areas and magnification contribute to changes in SMT acutance are examined. These rates provide a measure of the relative sensitivity of SMT acutance to changes in the system elements. Examples are drawn from an 8-mm color system and a color print system.

18 **Variation of MTC Area with Characteristics of Modulation Transfer Functions for Color Films,** R. G. GENDRON AND M. C. GODDARD, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y.*

Three characteristic vectors have been found that accurately represent the various shapes of the modulation transfer curves for a variety of color films. Certain scalar

amounts of these characteristic vectors will match the original MT curves closely. A linear combination of the scalars will also predict the MTC area. Since the rates of change in SMT acutance for a photographic system can be related to changes in MTC area, the rates of acutance changes can now also be connected more directly to the MT curves.

19 **MTF Measurement by Using a Spatial Frequency Target Generator,** TIMOTHY TROTT, *Newtek, Inc., Woodside, N.Y.*

A new type target for evaluating the MTF of photographic systems is described. This unconventional target provides a continuously variable range of spatial frequencies whose intensity is a sinusoidal function of the space coordinate. By using this target generator, together with light source, collimator, test bench, and recorder, it is possible to obtain the MTF of the photographic system. A description of the target generator will be given together with the range of resolution, aperture, focal length and field angles, over which measurements can be performed.

20 **Three-Bar Target Modulation Detectability,** FRANK SCOTT, *Perkin-Elmer Corporation, Wilton, Conn.*

A function relating spatial frequency to the minimum three-bar resolution target image modulation required for resolution is useful in photo-optical system design and evaluation. Using modulation detectability curves, the resolving power of a system can be predicted from its modulation transfer function. The methods used to measure the modulation detectability of several aerial films and examples of the use of modulation detectability curves are presented.

21 **The Production of Photographic Edges of Extreme Sharpness,** C. S. MCCAMY AND M. A. BERKOVITZ, *National Bureau of Standards, Washington, D.C.*

A method of producing sharp photographic edges of high quality has been developed. The method involves contact printing a piece of thin metal foil with a very fine-grain film and exposing with soft x-rays. The procedure used to obtain a very sharp and straight edge on one side of the thin foil is discussed. Several other experiments that were attempted but produced edges of lesser quality are briefly described.

22 **The Production of Variable-Transmission Sinusoidal Patterns and Other Images,** FRANK SCOTT, *Perkin-Elmer Corporation, Wilton, Conn.*

A method is described for producing variable-transmission images such as sine-wave patterns and spatial filters. Images of variable-area patterns designed to compensate for the nonlinear response of photosensitive materials and the modulation transfer functions involved in the process are linearly or curvilinearly smeared using simple devices. Essentially grainless, sinusoidally varying transmission patterns of high spatial frequency, with modulation values of nearly 1.0 and with little harmonic distortion have been made. The procedure is not limited to any specific photosensitive material. Where the variable-transmission image is used with a nonlinearly responding detector, compensation can be achieved for detector response.

Tuesday Afternoon, May 18th

Image Evaluation, Continued

Session Chairman: WILLIAM S. SHOEMAKER

23 **The Effect of Slit Misalignment on the MTF of the Microdensitometer,** ROBERT A. JONES, *The Perkin-Elmer Corporation, Norwalk, Conn.*

An analysis is made of the degradation that occurs in the MTF of a microdensitometer as a result of imperfect alignment between the slit of the microdensitometer and the edge of the image being traced. Alterations in the MTF of the microdensitometer are predicted as a function of angular misalignment, slit length to width ratio, and the effective slit width. The values of the misalignment angle are correlated with the values of the resulting fractional errors in the MTF of the microdensitometer.

24 **A Systematic Notation for Optical Density,** CALVIN S. MCCAMY, *National Bureau of Standards, Washington, D.C.*

The measured density of a sample depends upon the geometrical distribution of the incident flux, the geometrical nature of the system which evaluates the flux, the spectral quality of incident flux, and the spectral characteristics of the system which evaluates the flux. These facts may be expressed in functional notation in the form $D(g, g'; s, s')$, where the independent variables refer to the above factors. These variables may be given numerical values under most circumstances and, by standardization, all cases can be adequately described. The notation is simpler, more easily generalized, and more nearly self-explanatory than existing standard notation. Standardization of the notation is recommended.

Education in Photography

Panel Discussion: Education for Photographic Engineering from the Engineer's Viewpoint

25 **Discussion Leader:** HOLLIS N. TODD
Panelists: MAX BEARD, *U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.;* RONALD COLLINS, *3M Company, St. Paul, Minn.;* C. S. MCCAMY, *National Bureau of Standards, Washington, D.C.;* ROBERT KOHLER, *Itek Corporation, Lexington, Mass.*

Medical Photography

Session Chairman: JULIUS WEBER

26 **High Speed X-Ray Motion Picture Photography of Internal Heart Structures** DR. F. M. SONES, JR., *Cleveland Clinic Foundation, Cleveland, Ohio*

In the diagnosis of heart disease, high-speed x-ray motion pictures of internal heart structure are taken, with image amplification, on a fluoroscopic screen. Electrocardiograms are taken simultaneously as controls. Individual frames of the motion pictures are enlarged and printed; abnormalities are then studied with their help. Special stereo x-ray motion picture studies will be demonstrated.

27 **The Recording of Dynamic Events in Organs of Living Animals at the Microscopic Level,** EDWARD H. BLOCH, *Department of Anatomy, Western Reserve University, 2019 Adelbert Rd., Cleveland, Ohio*

A motion picture film will illustrate the progress that is being made to establish the cellular structure of organs in living animals by recording their microscopic images directly on motion picture film as well as by translating these optical images into electronic images and then recording these images. The film will depict the use of high-speed cinemicrography for analyzing the cellular flow pattern in small arteries and veins. The goal of these studies is to secure quantitative morphological and biochemical data at the cellular level of major organs like the lung, liver, and kidney. Small animals were anesthetized, the organ exposed, and then transilluminated with monochromatic light at wavelengths between 405 and 650 μ. The organs were examined at magnifications ranging between 500 and 1500 $\times$. The images were either recorded directly on Kodachrome Type II film or on Tri-X film from a video monitor. Optical and electronic images were secured with details commensurate with and limited by the optics of the light microscope. The technical problems will be discussed in regard to illumination, high-speed recording, and films.

28 **A Proposed Colored Radiographic System For Radiodontics,** JAMES A. LANGONE, RAYMOND EYNARD, AND J. SCOTT WILSON, *Rochester Institute of Technology, Rochester, N.Y.*

A color radiographic system is proposed to obtain colored representations for varying densities of subject material by using a tripack of three nonscreen x-ray films of

varying speed and by using dye-coupling development and reversal techniques where necessary. An investigation was carried out to demonstrate the feasibility of obtaining such a colored radiograph of subject material normally encountered in the field of radiodontics. Full-mouth, colored radiographs were attained using the proposed system with a tripack composed of three sheets of Ultra-Speed dental x-ray film and exposed by conventional radiodontic techniques.

29 **New Nikon Francon-Yamamoto Differential Interference Microscopes,** BERNARD FRIEDMAN, *Instrument Division of Nikon Inc., 109–111 Fifth Ave., New York, N.Y.,* AND JULIUS WEBER, *Beth Israel, Fordham, Misericordia, and Morrisania Hospitals, New York, N.Y.*

Two new polarization interference microscopes based on the differential method have been recently designed by M. Francon and T. Yamamoto, one for transmittance and one for reflected light. The design is based on the employment of Savart polariscopes between crossed polars. Examples of their use in biological and industrial research will be discussed and demonstrated.

30 **A Study of Lead Monoxide as a Medium for Medical X-Ray Electrophotography,** EUGENE S. ANOLICK, *General Electric Company, Chemical Development Operation, Pittsfield, Mass.*

The possibility of developing a high-speed, x-ray plate consisting of a film of powdered lead monoxide bound in an organic resin has been investigated. The use of lead monoxide was based on its absorption of x-rays and the known photoconductivity of the compound. A goal of ten times the speed of industrial selenium Xeroradiographic plates was set; a speed of four times that of selenium was obtained as determined by voltage measurements. The PbO source, resin, grinding, and heat treatment were found to have a direct influence on the measured speed.

Wednesday Morning, May 19th

Lasers in Photography

Session Chairman: JEROME S. GOLDHAMMER

31 *Invited Paper:* **Technical Applications of Optical Masers,** J. S. COURTNEY-PRATT, *Bell Laboratories, Murray Hill, N.J.*

32 **Spatial Filtering Experiments with Laser Illumination,** JOHN HOLEMAN, *General Electric Company, Advanced Technology Laboratory, Schenectady, N.Y.*

The invention of the gas laser makes practical the process known as a spatial filtering which can be used either to enhance any particular kind of information in a photograph or to extract this information. This makes it possible to mechanically recognize characters or objects at high speeds and under conditions which would tax human ability. Examples will be given of objects extracted from photographs under different conditions of contrast, size, and so forth.

33 **Enhancement of Weak Photographic Images by Coherent Optical Processing,** JOHN F. FORKNER AND JAMES W. JEWITT, *Aeronutronic Division of Philco Corporation, Newport Beach, Calif.*

A coherent optical technique for extracting weak image from background noise is described. Separately exposed negatives are assembled in a regular array; the similar array formed by the objects of interest has a spatial frequency spectrum sufficiently distinct from that of the noise background that a spatial filter can block much of the background energy. Ideally, the contrast of the image reconstructed after filtering will equal the number of photographs, N, used. This represents a significant gain over the $\sqrt{N}$ factor obtainable by superposition of weak negatives, a noncoherent enhancement technique often used.

34 **Laser Mapping Applications,** JOHN H. ATKINSON, JR., GLEN W. CHAPMAN, JULIUS C. GECSY, AND CHARLES W. SEAMER, *Aeronutronic Division of Philco Corporation, Newport Beach, Calif.*

A laser ranger can furnish the metric mapping required for aerotriangulation and elevation determination. Aerotriangulation requirements are best met by a fixed

geometry of spots projected on the surface at the six classical positions. Simultaneous photography of these laser spots on the prime exposure makes the system self-spotting and self-calibrating. Elevation determinations are best made by ranging to a large number of points. Ranging and spot photography present somewhat contradictory requirements for high power in a short pulse and high integrated energy respectively. Hybrid modulation techniques have been investigated with some resulting reciprocity failure data.

35 **Lunar Reconnaissance Landing Aid,** JOHN H. ATKINSON, JR. AND WILLIS D. MARSING, *Aeronutronic Division of Philco Corporation, Newport Beach, Calif.*

Aeronutronic suggests the use of a lightweight reconnaissance package as a landing aid for the early Apollo landing missions. Use of this package will give the astronauts topographic information progressing in accuracy from the order of kilometers available from earth to the order of dekameters from an 80-naut mi orbit to the order of meters from a 50,000-ft orbit. This information is presented on a timely basis in the form of stereo photography with overlaid contours and grid lines. This information can be used for successively finer site selection on the actual landing mission. During the actual landing, the same equipment can be used to give increasingly accurate meter readings of forward and cross slope and altitude with the camera providing documentary coverage.

36 **Photographing Laser Illuminated Satellites for Geodetic Purposes,** MICHAEL S. TAVENNER AND ROBERT L. ILIFF, *Terrestrial Sciences Laboratory, Air Force Cambridge Research Laboratories, Bedford, Mass.*

On January 21, 1965, an optical signal was transmitted from a ground station, reflected from an artificial satellite, and recorded both as a photographic image and as an electrical pulse from a photomultiplier tube. The transmitting equipment was a ruby laser with 250 joules output energy, 15-arc-min collimated beamwidth, and a 2.7 ms pulse duration. The receiving camera was a PC-1000 Ballistic Camera of 40-in. focal length, $f/5$ lens. The photographic image was about 50 μ in diameter and was recorded on a Kodak "Micro-flat" glass plate with 103F emulsion. The receiving photodetector used a 5-in. collecting lens and a 9558B EMI photomultiplier tube as the sensor. Effective size of the satellite reflector,

made of small corner cube reflectors, was about 100 cm^2 and the range was 1491 km as determined by independent tracking methods. A short history is given of the present state of development of this system at AFCRL, illustrating the need for improved stellar stereo-triangulation methods. Azimuth, elevation, and range can be obtained from a single observation, thus determining a passive satellite's position uniquely from one observing station.

Wednesday Afternoon, May 19th

Unconventional Photographic Systems

Session Chairman: JAROMIR KOSAR

37 **Evaluation of Zinc Oxide-Coated Electrophotographic Papers,** A. KAHN, C. T. RANDOLPH, AND T. M. CRAWFORD, *IBM Corporation, Los Gatos, Calif.*

In an application in which the amount of available light was limited, it was desired to determine the potential usefulness of zinc oxide-coated, electrophotographic paper without actual performance testing. The spectral characteristics of a number of zinc oxide-coated papers were obtained, and the effective utilization of the light from a specific light source was determined. Calculations were then made of the effective quantum yield of the papers.

38 **Noise on Electrofax Paper,** D. W. SEYMOUR, *Phillip A. Hunt Chemical Corporation, Palisades Park, N.J.*

Observations made with a small electrometer probe in close proximity to negatively-charged, zinc oxide-coated paper reveal local spatial fluctuations of the charge acceptance voltage of the order of twenty percent. The noisy charge distribution thus indicated results in highly divergent field patterns which, in turn, give rise to stronger dipole forces than formerly suspected. The noise is observed to decay slowly on exposure, leaving appreciable noise residue related to background. Examples are given of liquid toners for which forces on dipoles [dielectrophoresis] dominate the coulomb forces [electrophoresis] in the mechanism of image development.

39 **X-Ray Induced Discharge of Selenium Xerographic Plates,** J. NEYHART AND J. SCHOTTMILLER, *Xerox Corporation, 611 Holland St., Rochester, N.Y.*

The initial rate of loss of surface charge by exposure to ionizing radiation is a measure of the speed of selenium xerographic plates. The initial discharge slope, dQ/dt, was measured as a function of selenium thickness, applied field, range of charge carriers, and x-ray tube kilovoltage and filtering. The slope was roughly proportional to thickness for thin films and independent of thickness for thick films. It rose with applied field and did not completely saturate at high fields, suggesting that appreciable secondary photocurrents were present in the xerographic mode of operation. The initial slope also increased with hole and electron trapping ranges in a

qualitatively predictable way. Finally, the hardness of the radiation, determined by the kilovoltage and filtering, affected the discharge rate by varying the region in the film in which the charge carriers were produced.

40 **The Application of Gain Photoconductors to Charge Transfer Frost Xerography,** M. SMITH AND A. BEHRINGER, *Xerox Corporation, 611 Holland St., Rochester, N.Y.*

A new photographic method was recently reported in which an electrostatic latent image is transferred to a thermoplastic film which is then heat treated to create a deformation image. The feasibility of an improvement in the photographic speed of this system via the use of a one-carrier, trapping-type photoreceptor has been investigated. CdS layers showing high quantum gain and acceptable dark currents were prepared. Image development in the complete system was demonstrated with these layers. The moderate performance was attributed to variations in the oil coupling layer thickness caused by surface roughness. Present investigations with evaporated CdS films will be described.

41 **Photocharge Recording Process,** JOSEPH GAYNOR AND GORDON J. SEWELL, *Advanced Technology Laboratories, General Electric Company, Schenectady, N.Y.*

A new, grainless, dry, high-resolution, instant-development, photosensitive recording process is described. It is based on a "photovoltaic" mechanism. When thin deformable polymeric films containing a photochargeable material are exposed to a light image and then quickly heated, the films deform wherever incident photons have been absorbed. No prior sensitization to light is required. Reheating to a temperature higher than that employed for development erases the image and reuse is possible. A tentative mechanism to explain the photon-induced generation of electrical fields high enough to produce deformation will be discussed. Development and erasure characteristics, spectral response and characteristic curves which show sensitivity and gamma will be presented.

42 **Red Sensitive Photoplastic Recording Film,** JOHN J. BARTFAI, VERNON OZAROW AND JOSEPH GAYNOR, *Advanced Technology Laboratories, General Electric Company, Schenectady, N.Y.*

Photoplastic Recording Film has its main spectral sensitivity in the blue and near ultraviolet. The films to be described here possess photoconductive response through-

out the visible and near infrared with a peak in the 5000–7000 Å band. The sensitivity of the film as a photographic element was measured by the Modulation Efficiency Method developed for this type of film, using radiation in the aforementioned band. The sensitivity criterion of 1% Modulation Efficiency was attained with exposures of 0.03–7.0 μjoules/cm^2. (Obtained by extrapolation of measured values at 1–50 μjoules/cm^2.) The films were charged to give fields across them of 20–40 v/μ. Data will be presented describing the spectral dependence of the films' photo-induced decay characteristics as functions of exposure and field. Photographs taken with the film will be shown.

43 WITHDRAWN BY THE AUTHORS.

44 Third Dimension with Additive Color System for Motion Pictures, FRANCIS A. PALL, *General Dynamics/Astronautics, San Diego, Calif.*

The combination of the oldest principle of color theory and the latest development in optical science has been designed into a new, motion picture, additive color system. The camera is of conventional design. The film is standard black-and-white panchromatic. The projection is with normal frequency and single frame advancement. Unlike the conventional motion picture projection, in this system each frame will be projected three times, once from three different positions. The three adjacent full-size frames are simultaneously projected in one projector through three lenses plus three color filters. With this system, the full-size frame is used for the first time in additive color motion picture projection, and the third dimensional color picture becomes a reality. The natural living colors, produced by this design will result in a new "three dimension," which becomes so real that one has a participating experience which is typical of a live theater performance, rather than a movie film observation.

Thursday Morning, May 20th

Rapid Processing

Session Chairman: GORDON O. F. JOHNSON

45 **Ultrasonic Agitation of a Developer,** CHARLES L. SCAVRON AND EDWARD KOB, *Rochester Institute of Technology, Rochester, N.Y.*

The effects of ultrasonics during processing of photographic film were: an increase in speed and gamma; no change in fog; no change in developer temperature in either the emulsion layer or at the film surface; an increased fixing rate. These effects are attributed to local pressure changes during a resonant condition which increase solution diffusion rate at the film surface.

46 **A Compact, Rapid-Access Wide Film and Paper Processor,** HOWARD W. HOADLEY, *Houston Fearless Corporation, 11801 W. Olympic Blvd., Los Angeles, Calif. 90064*

The development of an experimental, continuous processing machine, the EH-52, is described. The processor applies high-temperature developer and lower-temperature fixer on sensitized materials up to 9½ in. wide, transported by a vacuum capstan. The daylight–darkroom machine is housed in 20 × 36 × 36-in., Type 316, stainless-steel honeycomb cabinet that provides structural integrity and thermal and acoustic insulation.

47 **70-mm Film Processor for Airborne Application,** ROBERT BUCKINGHAM AND ALAN MILLER, *Chicago Aerial Industries, Inc., Barrington, Ill.*

The processor, developed under contract for the U.S. Army Electronics Research and Development Laboratories, Ft. Monmouth, N.J., and designated EH-51, is an airborne 70-mm film processor which operates at continuously variable film rates from ½ to 75 ft/min while providing a constant image access time of 12 sec. The processor has five principal innovations in operation: (1) the use of continuous liquid monobath processing of 500 ft of 70-mm film; (2) the method of processing by a unique free-loop immersion of the film in the monobath without internal rollers, elevators, and guides; (3) continuously variable and accurately controlled film drive over a velocity range of 150 to 1; (4) a specially developed liquid seal permitting operation in any attitude while transporting and processing film; and (5) small size and weight as compared to conventional free-liquid systems.

48 **A New Film–Monobath Combination for Oscillography,** W. J. MORETTI, D. G. BUSHMAN, AND J. C. BARNES, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

A film process has been designed for use in oscillography and in related applications where in-line processing at variable rates is a desirable feature. A new film, Kodak RAR Film, Type 2490, has been specifically designed for high-temperature monobath processing, and a new monobath, MX-448-3, has been specifically designed to simultaneously develop and clear this film in 30 sec at approximately 100°F. Unusually broad latitude with respect to temperature, time, and agitation characterize the process, but it is vital that the mechanical component required to provide a complete processing system be designed with attention to the rather special characteristics of this new film–process combination.

49 **Rapid Access Processing of Cathode-Ray Tube Recording Films,** J. C. BARNES, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

Investigation of the factors involved in rapid processing at elevated temperature has led to new films and chemical solutions which are specially designed for very rapid processing of cathode-ray-tube recordings. An experimental, laboratory model of a complete rapid processing system was constructed in order to study various aspects of the problem. Using Special Dacomatic Film, Type SO-211, together with a specially formulated developer (MX-509-4) and fixer (MX-509-2) it was possible to demonstrate useful development in less than 2 sec at 140°F, and clearing in less than 2 sec at the same temperature. With rinsing and drying requiring 2 sec each, a processing system is shown to produce rinsed, dried film of high quality in a total time of less than 8 sec.

50 **Rapid Access Hard Copy from CRT Displays,** E. P. SMITH, R. P. MASON, AND W. L. KACIN, *Photomechanisms, Inc., Huntington Station, N.Y.*

A newly produced equipment combines the photographic sensitivity and rapid pulldown ability of 35-mm film with moderate cost of electrostatic paper to generate hard copy from on-line displays or TV systems. The unit will accept several commands per sec and generate prints at the rate of 12 per min with only a 26-sec throughput time.

The newest materials available have been utilized to produce a good tone scale when required in the output print. Equipment features, operation, and applications are presented.

51 **A Rapid-Access Kodak Bimat Process,** L. W. TREGILLUS AND R. L. WHITE, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

The Kodak Bimat Process may be applied to the rapid, continuous production of positive images in cathode-ray-tube recording without the use of free liquids. The Bimat Film, charged with the processing chemicals held in a hydrophilic layer, is placed in contact with the just-exposed negative, separated and dried. Sensitometric control is obtained by adjustment of contact time, between 10 and 30 sec, and the temperature, between 110 and 130°F. The design of the processing equipment must encompass the principles of Bimat processing and the needs of the specific application.

Thursday Afternoon, May 20th

Image Formation and Manipulation

Session Chairman: HOWARD G. SILKMAN

52 **A Mechanical Method for Automatically Maintaining the Focus of an Optical System,** W. E. WHITE AND E. A. GEIER, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

This paper describes a method of maintaining the focus of an optical system when one conjugate is fixed and the problem is to correct for adventitious variations in the second conjugate. The method is especially applicable to slide projectors, where the adventitious variations arise from variations in slide construction and position. It consists in directing a weak jet of air into the space between the slide and a curved reference surface (the face of the condenser) close to the film, where the air flow is restricted so that the pressure of the emergent air can be used as an index of the exact position of the slide with respect to the projection lens. A gage to measure this pressure is associated with a servomechanism for restoring the position of the slide to a few thousandths of an inch—far closer than can be detected from the sharpness of the screen image.

53 **Computer Simulation of a Photo-Optical, Image-Forming System,** DIETER P. PARIS, *International Business Machines Corporation, Systems Development Division, San Jose, Calif.*

A program was developed to facilitate the simulation of (one-dimensional) images in a photo-optical, image-forming system. The single (or cascaded) system may consist of any combination of linear or nonlinear components such as lenses, emulsions, and components, described by their spread function or optical transfer function. Design goals are: (1) simplicity of the input language, in which the user specifies his particular system configuration to the program; (2) capability for requesting intermediate output at any point in the sequence of systems components; (3) repeat runs with varied parameters.

54 **Dodging Control by Autogenous Masking,** SEYMOUR L. HERSH AND SUSAN CLEAVES, *U.S. Army Electronic Laboratories, Fort Monmouth, N.J.*

An evaluation of a dodging technique using simultaneous exposure and development is discussed. During the process, developed silver acts as a mask on the subsequently continuing exposure. Methods for sample preparation, control of dodging, and a sensitometric evaluation are presented. Process automation techniques are proposed.

55 **The Effect of Special Development Procedures on the Physical Properties of Radiographic Emulsion Grains,** WILLIAM L. MCLAUGHLIN, *Radiation Physics Division, National Bureau of Standards, Washington, D.C.*

The radiographic response can be enhanced somewhat following exposure, through latensification or by means of special development techniques. In the present study, the reasons for the greater sensitivity of the specially treated emulsions are investigated through examination of developed emulsion grains. A sensitive commercial radiographic film was given small gamma-ray doses and, following special latensification or development, was subjected to analyses of grain properties (grain concentration, area density of developed silver, and photometric equivalent) and to photo- and electron micrography. The response enhancement in the case of latensification is found to be caused by a rapid increase in grain size with exposure; with special physical development techniques, it is related to the rise in the number of grains developed.

56 **The Direct Image in Vesicular Photography,** NORMAN T. NOTLEY, *Kalvar Corporation, New Orleans, La.*

There are two routes to the direct copy vesicular image—reversal processing and flash processing. In the first, an image defining exposure produces a latent image of dissolved nitrogen which is allowed to diffuse out from the film before an overall exposure and development. Flash processing eliminates the need for diffusion. The activation energy of the sensitizer is absorbed from the flash and is liberated together with the Decomposition Heat of the sensitizer (196 cals/g) in an adiabatic reaction which can give an instantaneous temperature rise localized in the imaging area of perhaps 220°C and cause selective development. The direct image is obtained, developed, and fixed in just two steps, an image defining exposure from an incandescent or arc source and an overall exposure to xenon flash tube. Gamma is adjustable between 2 and 4 without significant effect on the maximum or minimum densities, just by varying the voltage on the flash.

57 **A New High-Resolution, High-Speed, Continuous Contact Printer,** RICHARD A. WALKER, *Houston Fearless Corporation, Los Angeles, Calif.*

This paper will describe a new high-speed continuous contact printer capable of achieving very high resolution photographic reproductions. The heart of the printer is a large optical-quality glass drum and a second rubber-coated contact drum. The original film-and-print stock sandwich are kept in intimate contact by hydraulic cylinders on the contact drum, while the film is transported by driving the glass drum. Other aspects of high resolution contact printing, such as the nature of the light source and "liquid-gate printing," will also be discussed. Two operational printers will be described. The first is a continuous contact printer capable of achieving 400 l/mm on 70 mm–9½ in. wide roll film at printing speeds up to 120 ft/min. The second printer is a multistation printer with four printing stations arranged around the periphery of the drum in order to make four simultaneous prints on a single pass of the original film thereby achieving an effective output speed of 480 ft/min.

Friday Morning, May 21st

Further New Theory, Mechanisms and Materials

Session Chairman: HEINZ F. NITKA

58 **Photographic Development from the Viewpoint of Franck-Condon Electron Transfer,** J. Q. UMBERGER, *Photo Products Department, E. I. du Pont de Nemours & Company, Inc., Parlin, N.J.*

Hydroquinone actively develops silver via the symmetrical anions, $Q^{=}$ and $Q^{\cdot -}$ (radical), readied for *quick* electron transfer by proton removal. The unsymmetrical anion HQ^{-}, lacking resonance-stabilization during electron transfer, develops silver at a rate only $\frac{1}{100}$ that of $Q^{\cdot -}$. Because $Q^{=}$ is slow in adsorption, it develops with a rate about $\frac{1}{10}$ that of $Q^{\cdot -}$. It approaches the $Q^{\cdot -}$ rate when cationic surfactants or dyes are present. Since atomic rearrangement is involved, $SO_3^{=}$ combines "slowly" with oxidized developers. Thus $Q^{\cdot -}$ contributes to hydroquinone's contrasty development and superadditivity in mixtures. Two types of superadditivity are delineated, *moderated* and *explosive*, depending on $SO_3^{=}$ concentration.

59 **Nonlinear Optical Effects in Silver Halides,** H. D. HUNT AND R. FITZSIMMONS, *Photo Products Department, E. I. du Pont de Nemours & Company, Inc., Parlin, N.J.*

Double photon absorption (a nonlinear process) by silver halide emulsions at 77°K is evident from the blue and green luminescence produced by red ruby laser irradiation. The emission under certain conditions is proportional to the square of the laser power. A prior exposure to ultraviolet radiation enhances this luminescence. The enhancement is a linear process in which a red photon ejects a trapped photoelectron. Double photon absorption as well as ultraviolet absorption produce trapped electrons. Silver halide emulsions prepared in various ways were examined.

60 **Syneresis in Gelled Photographic Emulsions and in Gelatin Gels,** EDGAR B. GUTOFF, *Emulsion Laboratory, Polaroid Corporation, Waltham, Mass.*

Syneresis, the exudation of a liquid by a gel, can be reduced or avoided in gelled emulsions as in gelatin gels by maintaining a high gelatin concentration and eliminating

the use of dehydrating agents such as methanol. Syneresis is most severe at the isoelectric point. The silver halide grains in the emulsion act as an inert diluent with regard to syneresis. The adhesion of the gel to the walls of the container and also additions of electrolytes reduce syneresis. The properties of the gelatin affect syneresis.

61 **The Use of Simultaneous Latensification for the Photographic Detection of Threshold Information,** J. C. MARCHANT, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y. 14650*

The threshold detection limit of most high-speed negative films can be extended by latensification. The purpose of this paper is to show that the threshold limit can be extended even further when the latensification exposure is made simultaneously with the image exposure rather than before or after. It will be shown that, by using this technique, cathode-ray-tube traces can be recorded with sweep speeds up to 5 × greater than those which are normally just detectable.

62 **A New, Simplified Method for the Sensitometry and Grading of Photographic Papers,** YASUSHI OHYAMA, *Mitsubishi Paper Mills Ltd., Photo and Repro Department, Tokyo, Japan*

A simplified method using the two terms, "Principal Exposure Scale" (PS) and "Steep Scale" (SS), for the evaluation of gradational characteristics and the term, "Standard Grade Number" (Gs), derived from PS for the grading of various photographic papers is proposed. As the point which determines the sensitivity, the midpoint of density range corresponding to PS is chosen. The method is suitable for an automatic determination of characteristics, and the idea is consistent with the DIN proposal and not incompatible with the ASA method. The PS values are almost identical with the "Partial Exposure Scale" (PES) values recently introduced by Sweet et al. and Carnahan.

63 **Permanence of Processed Estar Polyester Base Photographic Films,** P. Z. ADELSTEIN AND J. L. MCCREA, *Eastman Kodak Company, Kodak Park Works, Rochester, N.Y.*

The use of photographic films as permanent records is of importance to a great many archivists. However, there has been little experience with the newer type polyester supports. Studies have been made on the chemical sta-

bility of Estar polyethylene terephthalate and it compares very favorably with cellulose triacetate. No effect of the base on the stability of the processed emulsion layer or silver image was found. Adequate adhesion between gelatin emulsion and polyethylene terephthalate is more difficult to obtain. However, it is believed that Estar base films have satisfactory emulsion adhesion when stored under moderate conditions.

64 **A Gold Protective Treatment for Microfilm,** R. W. HENN AND BERNADETTE D. MACK, *Eastman Kodak Company, Rochester, N.Y.*

Microfilm may be protected against oxidative attack and atmospheric gases by treatment with an acid solution of an aurous-thiourea complex. The quantity of gold entering the image is sensitive to time of treatment, agitation, and to the gold concentration of the solution, but is insensitive to the nature of the emulsion, image density, temperature, and mixing or formula variations. It is concluded that the rate-determining step is the diffusion of the gold protective solution into the emulsion.

65 **The Properties of Gold-Treated Microfilm Images,** R. W. HENN AND D. G. WIEST, *Eastman Kodak Company, Rochester, N.Y.*

The photographic image is made much more resistant toward oxidation or reaction with atmospheric gases by treatment with a gold protective solution which deposits a layer of gold on the grains. A typical solution contains gold chloride, thiourea, and tartaric acid. The image is further stabilized, and some physical protection induced, when a formaldehyde supplementary hardening bath is used after the gold treatment. The gold treatment imparts a rather more neutral image tone, but does not increase contrast nor decrease sharpness. Gold-treated films, with and without a formaldehyde after-bath, have been subjected to a series of accelerated tests employing oxidizing agents and moist incubation conditions. Gold-treated films showed marked resistance in all tests. However, the variation employing the supplementary formaldehyde treatment showed marked advantages in resistance to strong peroxide atmospheres.

Friday Afternoon, May 21st

Engineering Exhibits Presentations

Session Chairman: WOODLIEF THOMAS, JR.

66 **Laboratory-Scale Emulsion Coating Device,** T. T. HILL, *Consultant, Rochester, N. Y.*

For laboratory-scale coatings of photo emulsions (or nonsensitive layers) onto flexible supports (paper, film-base, etc.), this is a smooth-surfaced block with temperature control and a vacuum-channel for paper holddown during coating. The separate coating-head used with the block will also be shown.

67 **Laboratory-Scale Photo Emulsion Washing Setup,** T. T. HILL, *Consultant, Rochester, N.Y.*

For laboratory scale gelatin–silver halide emulsions which need washing, a simple, easily cleaned and easily used setup is made from plastic laboratory equipment, replacing the awkward, unsafe glass "percolator" cones. It is usable in batteries.

68 **Two Electronic Image Motion Stabilization Systems,** E. R. ARAZI, *Itek Corporation, Lexington, Mass.*

One system is a hand-held 60 power monocular where the image is electronically stabilized despite vibration of the instrument. The second system is a small telescope equipped with an electronic image motion stabilization and tracking system. A test target is placed a few yards away and mechanically vibrated in high frequency random noise. The system stabilizes the image to its original sharpness. This is analogous to the situations in high acuity space photography in the presence of atmospheric scintillations, or vibration of the telescope, etc.

69 **Photoelastic Analysis of a Solid Propellant Rocket Grain Model Using Photoelasticity,** H. P. ADAM, *Douglas Aircraft Co., Inc., Santa Monica, Calif.*

Photoelasticity is a tool used to analyze stresses and strains in complicated structures. When a birefringent plastic model representing the cross-section of a solid propellant rocket grain is loaded with external pressure and viewed in a polariscope, a fringe pattern is observed. The fringe pattern provides the necessary data for ob-

taining stress distributions and the stress concentrations. Photographs of these fringe patterns supply the original recorded data taken for this type of study.

70 **70-mm Film Processor for Airborne Application,** R. BUCKINGHAM AND A. MILLER, *Chicago Aerial Industries, Barrington, Ill.*

The processor, developed under contract for the U.S. Army Electronics Research and Development Laboratories, Ft. Monmouth, N.J., and designated EH-51, is an airborne 70-mm film processor which operates at continuously-variable film rates from ½ to 75 ft/min while providing a constant image access time of 12 sec. The processor has five principal innovations in operation: (1) the use of continuous liquid monobath processing of 500 ft of 70-mm film; (2) the method of processing by a unique free loop immersion of the film in the monobath without internal rollers, elevators, and guides; (3) continuously-variable and accurately-controlled film drive over a velocity range of 150 to 1; (4) a specially-developed liquid seal permitting operation in any attitude while transporting and processing film; and (5) small size and weight as compared to conventional free liquid systems.

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